

Optical Process Unit, Image Generation System  
Using the Same and Optical Process Method of the  
Same

5                                    FIELD OF THE INVENTION

          The present invention relates to an optical process unit  
for image display apparatus further specifically to an optical  
process unit of a high definition image generation device that  
can be used for a stereoscopic image display and a method of  
10 optical process realizing the high definition stereoscopic  
image display.

BACKGROUND OF INVENTION

          As a conventional technology to realize a high definition  
15 stereo image display, a green-color pixel shifting method as  
described in the following paragraph has been proposed. As for  
a stereoscopic viewing technology, polarizing glasses are  
well-known for a polarized dual-view stereo display to realize  
such stereo image display.

20           To begin with, a conventional display apparatus using the  
green-color pixel shifting method will be explained by using  
the figure 6. FIG. 6 shows a schematic that shows a display  
system 50 based on the technology used for the conventional  
display apparatus. The display system comprises an RB  
25 projection device 52, a dual G projection device 51 and a screen  
43, where RB and G stand for red-color and blue-color lights  
and green-color light, respectively.

          The RB projection device 52 is a projection device that  
comprises a lamp 31, a project lens 32 and an RB optical unit  
30 that projects R image and B image to a screen 43.

          The dual G projection device 51 comprises lamps 31,  
projection lenses 32 and a dual G optical process unit 10 that  
projects a dual G image consisting of a G image and a

pixel-shifted G image onto a screen 43.

The R image, G image (and the pixel-shifted G image) and B image respectively correspond to images of red-color, green-color and blue-color which are segregated for three primary colors by three display devices (or color panels)

The dual G optical process unit 10 will be explained by using the figures 2, 6 and 7. FIG. 7 is a block diagram that shows a composition of a conventional dual G optical process unit 10. The conventional dual G optical process unit comprises a light source lamp 31 (shown in FIG. 6), G dichroic mirror 2 that filtrates the green-color light off a white light emitted by the light source lamp 31 penetrating therethrough, a polarizing beam splitter PBS 11 that segregates G light into two polarized beams as S wave and P wave as called G light-a and G light-b which are orthogonal to each other, PBS 5 and PBS 6 that reflect G light-a and G light-b into reflective liquid crystal devices 7 and 8, respectively, as well as the G light-a and G light-b traveling through the PBS 5 and PBS 6, two half-wave plates 12 and 13 being set in the path of G light-b, a polarized beam splitter PBS 14 that leads polarized two beams of G image lights (as G image light-a and G image light-b) into a projection lens 32. The polarized beam splitter as abbreviated as "PBS" allows the light being normally and parallelly polarized against the surface of PBS to travel through and reflect upon the PBS, respectively. The dichroic mirror allows to filterate only the light that has a predetermined wave length to transmit therethrough.

The operation of this optical process unit is explained. A G light passes through G dichroic mirror 2 once a white light emitted from the light source lamp 31 is input thereto. The G light which is isotropically polarized is input to the PBS plate as PBS 11 and the P wave is reflected as G light-a and S wave is transmitted as G light-b. The behaviors of both G light-a and G light-b are explained as bellows.

(G light-a)

The G light-a (P wave) that is reflected at the PBS plate

PBS 11 is incident onto PBS 5 is reflected to a reflective liquid crystal device 7. The G light-a is reflected under the condition that the polarization is rotated 90 degrees at the reflective liquid crystal device 7. The polarized reflected  
5 G light-a works as an image light called as a G image light-a of which polarization is S wave. The G image light-a can travel through the PBS 5 and is incident to PBS 14 but transmits PBS 14 due to the polarization as S wave. Finally the G image light-a goes to a projection lens 32.

10 (G light-b)

The G light-b (S wave) that transmits through PBS plate PBS 11 is incident onto a half-wave plate 12 and the polarization of G light-b is rotated. Then the G light-b (now P wave) that is incident to PBS 6 is reflected to a reflective liquid crystal  
15 device 8. The G light-b is reflected under the condition that the polarization is rotated 90 degrees in the reflection at the reflective liquid crystal device 8. The polarized reflected G light-b works as an image light called as a G image light-b of which polarization is S wave. The G image light-b passes  
20 through another half-wave plate 13 where the polarization is rotated in another 90 degrees and is incident to PBS 14 as P wave. Then the G light-b is reflected at PBS14 and finally goes to a projection lens 32.

In this system, a G image light and a pixel-shifted G image  
25 light are made from the G image light-a (S wave) and G image light-b (P wave), respectively. These two G image lights are projected onto the screen 43 with R image light (S wave) and B image light (S wave) which are projected by RB projection device 52. Then a high definition image display can be  
30 obtained.

As for the green-color pixel-shifted high definition image display has been proposed by a paper "A wide-screen projection of 4k x 8k pixels" (Ref. 1).

A polarized dual-view stereo display is to realize such  
35 a stereo image display by the observer who uses polarized glasses that he or she sees two images by the right and left

eyes where the two images have different polarizations provided by two display devices.

Reference:

- 5       Ref. 1;       K. Hamada, M. Kanazawa, I. Kondoh, F. Okano,  
                  Y. Haino, M. Sato and K. Doi, "A wide-screen  
                  projector of 4k x 8k pixels", No. 46.3,  
                  Symposium of SID (Society for Information  
                  Display) (2002).

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          In the conventional green color light pixel-shifted image display device, the normal image and the pixel-shifted image have different polarization (mutually orthogonal to the other) each other as P wave and S wave and are projected to the screen.

15   In this polarization scheme, the polarization glasses to filtrate an image to the right-eye sight and left-eye sight that allows a stereo image viewing may pass either P wave or S wave of the pixel-shifted image or P wave rich or S wave rich image (of the pixel-shifted image) depending on the compliance to the

20   alignment of the polarization of the polarizing glasses. Therefore, the composition of the total pixel-shifted image which is a mixture of the normal polarization image and orthogonal polarization image, each having the normal image component and the pixel-shifted image component, loses the

25   balance between two image components upon the polarization of the polarizing glasses. In the projectors to project the image onto the screen of which image is viewed by the polarization glasses to produce stereo viewing image, the difference of the polarization may work as to select P wave or S wave, therefore

30   the total pixel-shifted image loses the balance between the normal image component and the pixel-shifted image in the optical process for such projection. In other words, it is not possible to keep the compatibility between the G pixel-shifted image processing technology and the polarized stereo image

35   processing technology since both processing uses the polarization technology.

BRIEF SUMMARY OF INVENTION

In the conventional technology, a polarization beam splitter makes two G lights necessary for generating the normal  
5 image component and the pixel-shifted image component in  
segregation and the composition into a single beam is done by  
using the difference of the polarization. The present  
invention does not use such difference of the polarization but  
the slight difference of the wave length selectivity for the  
10 segregation and the composition. For this purpose, dichroic  
mirrors alter the polarizing beam splitters which have been used  
in the conventional technology. The present invention can be  
advantageous to generate the normal image components and the  
pixel-shifted image component in a single polarization, and  
15 therefore such optical process can be directly applied to the  
image sources for the polarized dual-view stereo displays for  
the purpose of such stereo image displays. In a further  
advantage, the present invention can provide an optical process  
unit that serves for the display system featuring high fidelity  
20 stereo image display and the system thereof, wherein the high  
fidelity capability is realized with the pixel-shifted image  
for G light.

DESCRIPTION OF DRAWINGS

25 FIG. 1 is a block diagram that shows the construction of  
the optical process unit according to the first embodiment of  
the present invention.

FIG. 2 is a drawing that shows the spectrum of the green  
light in a range of wave length  $\lambda 1$  to  $\lambda 2$  at the center  
30 wavelength of  $\lambda 3$ .

FIG. 3 shows optical behavior of the green light at the  
dichroic mirror as traveling through and reflecting upon.

FIG. 4 is a schematic that shows the construction of the  
projection device.

35 FIG. 5 is a schematic that shows a stereo image generation  
system according to the second embodiment of the present

invention.

FIG. 6 is a schematic that shows the conventional high fidelity image generation system.

FIG. 7 is a block diagram that shows the conventional dual  
5 G optical unit.

FIG. 8 is a flow chart that shows the process done in the optical process unit according to the first embodiment of the present invention.

10 DETAILED DESCRIPTION OF THE INVENTION

The fundamental construction of the present invention is formed as follows. The optical process unit comprises a filtering means that selects G light, a polarizing means that selects a certain polarized light component, a resolution means  
15 that resolves the G light into the first light beam and the second light beam, the first and the second orientating means that change direction of the first second light beams, the first and the second image information superimposing means that superimpose image information thereon, an image light composing  
20 means that composes the first image light and the second image lights into a single image light. These optical elements work for the principal optical behaviors to realize the present invention.

In the optical process unit constructed as described  
25 above for the present invention, the filtering means discriminates a colored light which has a predetermined wavelength range from a white light and filtrates it off the white light at the first stage. Then the polarizing means selects a certain polarized light component from the colored  
30 light so that the light component is compliant to the linearly polarizing direction of the polarizing means and lets such linearly polarized light to pass therethrough. The linearly polarized colored-light is divided into two kinds of light by using a wave length resolution means so that the linearly  
35 polarized colored-light is resolved at a certain wave length to the first light beam and the second light beam. The first

orientating means changes the direction of the first light beam to the first reflective display device and lets the output light, that is a reflected light of the first light beam at the first reflective display device, pass therethrough. The second orientating means changes the direction of the second light beam to the second reflective display device and lets the output light, that is a reflected light of the second light beam at the first reflective display device, pass therethrough. The first passing light from the first orientating means and the second passing light from the second orientating means have image information at the reflections by means of the first and the second reflective display devices and are called the first and the second image lights, respectively. At the final stage of the optical process unit, the image light composing means composes the first and second image lights into a single image light propagating to a projection lens. The composition is realized in a manner such that the first image light straightly passes the two-light composing means and the second image light is changed of the propagation direction therein, or vice versa. All of the above optical components that function the above means are aligned in a way such that the first and the second image lights are collimated to be composed into a single image light in the final stage.

The detail functions of the optical elements constructing this optical process unit are explained. Assuming the linearly polarized light to be processed in this optical process unit has only a polarization of P wave and has a predetermined wave length  $\lambda_3$  in the range over  $\lambda_1$  to  $\lambda_2$  wherein a wave length  $\lambda_3$  is in a spectrum range of wave length between  $\lambda_1$  and  $\lambda_2$ , the optical process unit filtrates the white light into a predetermined wave length light and selects P wave by the polarization means. Therefore the selected light has a color spectrum in the predetermined wave length  $\lambda_3$  and P wave linear polarization. This light is then resolved into two light beams by a wave length resolution means such that the first light beam has the wave length as  $\lambda < \lambda_3$  and the second light beam as

$\lambda > \lambda_3$ . The first and the second orientating means set the direction of the propagation of the first and the second light beams to the first and the second reflective display devices, respectively. The first image light ( $\lambda < \lambda_3$ ; P wave) and the second image light ( $\lambda > \lambda_3$ ; P wave) after reflecting at the first and the second reflective display devices propagate to the image light composing means that composes the first image light ( $\lambda < \lambda_3$ ; S wave) and the second image light ( $\lambda > \lambda_3$ ; S wave) into an identically single image light which directs toward a direction in a single optical axis. Both the first and the second lights reflected at reflective display devices rotate the polarization in 90 degree and the P wave polarization turns into S wave. Therefore the two image lights are S waves. The optical process unit process the white light into two image lights as ( $\lambda < \lambda_3$ ; S wave and  $\lambda > \lambda_3$ ; S wave).

Further advantage of the optical process unit in the present invention is provided in the following construction. The optical process unit has a filtering means that filtrates the G light off a white light. The polarizing means selects a certain polarized G light component from the G light so that the light component is compliant to the linearly polarizing direction of the polarizing means and lets such linearly polarized G light pass therethrough. The linearly polarized G light is divided into two kinds of G light by using a wave length resolution means so that the linearly polarized G light is resolved at a certain wave length to the first G light beam and the second G light beam. These two G light beams propagate to the first and the second orientating means which set the direction of the propagation of the first and the second G light beams to the first and the second reflective display devices, respectively. Both the first and the second G light beams reflected at reflective display devices turn into the first image G light and the second image G light and propagate to the image light composing means that composes the first image G light and the second image G light into an identically single image G light which directs toward a direction in a single



optical axis.

All of the optical components that construct the optical process unit of the present invention are properly aligned so that the first image G light and the second image G light are composed into an identically single image G light that travels toward the projection lens.

The advantage of the optical process unit in the present invention provides further invention explained in the following construction. An image generation device is constructed with an optical process unit in the present invention and the other image generation device is constructed with another optical process unit with a polarizer which rotates the polarization of the image light emitted by the optical process unit. The former image generation device is constructed with an optical process unit that emits G light (called G image generation device for the right eye) and the latter image generation device is constructed with an optical process unit that emits G light (called G image generation device for the left eye). The former image generation device is constructed with an optical process unit that emits R and B lights (called RB image generation device for the right eye) and the latter image generation device is constructed with an optical process unit that emits RB light (called RB image generation device for the left eye). Further invention is implemented by the image generation system that is composed of these four image generation devices. The image generation devices for the right eye (wherein no polarizers are used) and for the left eye (wherein polarizers are used) can be alternated for right eye versus left eye.

According to the above construction of the image generation devices, the G image generation devices project image G lights, which include two ranges of the different wave lengths, to a screen. The RB image generation devices project image RB lights to the screen. By this system construction, a high fidelity image can be projected onto the screen. The image generation devices assigned for the right eye and the left eye project lights, which are mutually orthogonal, to the

screen.

The optical process unit with regard to the present invention functions for the image generation in a method that processes the light used for the application thereof. The optical light process in the present invention is explained as follows.

The optical process unit has a filtering step to filtrate a color light having a predetermined wave length off a white light, a polarizing step to selects a certain linearly polarized light component from the filtrated color light, a wave length resolving step to resolve the linearly polarized light into two light beams as the first light beam and the second light beam divided at a certain wave length. Further more, the optical process unit has an orientating step so that the propagation directions are changed as the first and the second light beams propagates towards the first and the second reflective display devices, respectively. At image information superimposing step, the first and the second light beams turn into the first and the second image lights after being reflected on the first and the second reflective display devices, respectively, where image information is superimposed to the light beams. As a final step, the optical process unit has an image light composing step so that the first and second image lights are composed into an identically single image light which directs toward a direction in a single optical axis.

The details of embodiments regarding the present invention are explained using the drawings.

#### First embodiment

The optical process unit 1 in the first embodiment is explained using the figures 1 to 3. FIG. 1 is a block diagram that shows the construction of the optical process unit according to the present invention. FIG. 2 shows an explanatory schematic of the spectrum of the green-color light, where the green-color light has a range of the wave length from  $\lambda 1$  at the lower limit to  $\lambda 2$  at the upper limit with  $\lambda 3$  at the central

wave length. FIG. 3 schematically shows G light can be divided into a reflected G light and a transmitting G light by a dichroic mirror, provided the incident light is polarized in parallel to the surface of the dichroic mirror. The dichroic mirror  
5 reflects a light that has a certain range of the wave length and passes another light that has another range of wave length.

The optical process unit as shown in FIG. 1 comprises a G dichroic filter 2 (a filtering means), a polarizer 3 (a linear polarizing means) that selects G light of which polarization  
10 direction is compliant to the direction of the polarizer, a dichroic mirror 4 (called as wave length resolution means) that resolves the linearly polarized G light into two light beams as the first light beam (called as G light-a) and the second light beam (called as G light-b) divided at a predetermined wave  
15 length, two polarizing beam splitter as PBS 5 and PBS 6 that respectively change the propagation direction of the G light-a and G light-b towards reflective liquid crystal devices 7 and 8 (called as the first and the second liquid crystal display devices, respectively), reflective liquid crystal devices 7 and  
20 8 that superimpose image information to the first and second light beams in the reflection at the reflective display devices 7 and 8 so that the first and second light beams respectively turn into the first and second image lights and a dichroic mirror 9 (called as an image light composing means) that composes the  
25 first and second image lights into an identically single image light which directs toward a direction in a single optical axis.

The dichroic filter 2 is a filtrating device that passes the light, being in the range of the wave lengths between  $\lambda_1$  and  $\lambda_2$ , but does not pass the other light. The polarizer 3  
30 filtrates P wave component off the G light passing through the dichroic filter 2.

The dichroic mirror 4 reflects G light-a ( $\lambda < \lambda_3$ ; P wave) and passes G light-b ( $\lambda > \lambda_3$ ; P wave) of the G light which is in the range between  $\lambda_1$  and  $\lambda_3$  with the central wave length  
35 at  $\lambda_3$ . Strictly speaking, G light-a and G light-b have different wave lengths and therefore the color of the light is

slightly different from each other. However for visual perceiving for human eyes cannot distinguish each of the lights when the lights are presented with other color lights which is a typical case for the optical image generation. Therefore the  
5 G light-a and G light-b are both perceived as G lights.

PBS 5 changes the direction of G light-a in the reflection towards the reflective liquid crystal 7 as well as pass G image light-a, being reflected at the reflective liquid crystal 7, through. PBS 6 changes the direction of G light-b in the  
10 reflection towards the reflective liquid crystal 8 as well as passes G image light-b, being reflected at the reflective liquid crystal 8, through.

The reflective liquid crystal 7 rotates the polarization of G light-a in 90 degrees and turns it G image light-a ( $\lambda < \lambda_3$ , S wave) after imposing the image information upon the  
15 reflection at the reflective liquid crystal 7. The reflective liquid crystal 8 rotates the polarization of G light-b in 90 degrees and turns it G image light-b ( $\lambda > \lambda_3$ , S wave) after imposing the image information upon the reflection at the  
20 reflective liquid crystal 8.

The dichroic mirror 9 reflects G image light-a ( $\lambda < \lambda_3$ , S wave) and passes G image light-b ( $\lambda > \lambda_3$ , S wave). In the present alignment of the dichroic mirror 9, G image light-a ( $\lambda < \lambda_3$ , S wave) that propagates from the reflective liquid crystal  
25 is folded in 90 degrees thereat. The dichroic mirror 9 passes G image light-b ( $\lambda > \lambda_3$ , S wave). As the result, G image light-a and G light-b are composed into an identically single image light which directs toward a direction in a single optical axis, for which the alignment of all these optical components is  
30 properly arranged.

The optical process unit 1 as described above filtrates G light that has the wave length range between  $\lambda_1$  and  $\lambda_2$  off the white light emitted from a light source and passes the G light by using a G dichroic filter and selects P wave component  
35 from the G light propagating from the dichroic filter 2 by using a polarizer 3. The optical process unit 1 resolves G light

(P wave) into G light-a ( $\lambda < \lambda_3$ , P wave) and G light-b ( $\lambda > \lambda_3$ , P wave) by using the dichroic mirror 4 and orients these lights to PBS 5 and PBS 6 that orient the lights to the reflective liquid display 7 and 8 as well. The optical process unit 1 superimposes the image information to the G light-a and G light-b as propagating as explained above by using the reflective liquid display 7 and 8. Then G light-a and G light-b turn into G image light-a ( $\lambda < \lambda_3$ , S wave) and G image light-b ( $\lambda > \lambda_3$ , S wave) and the optical process unit composes a single image light from G image light-a and G image light-b by using a dichroic mirror 9, wherein the single image light has a single optical axis.

The step of optical process carried out by the optical unit 1 is explained using FIG. 1 to FIG. 8. FIG. 8 is a flow chart that shows the optical process of the optical process unit 1.

(filtering step)

The G dichroic filter 2 filtrates G light which has a wave length in the range between  $\lambda_1$  and  $\lambda_2$  off a white light emitted from a light source and incident thereto and passes the filtrated G light (Step S1). The "G light which has a wave length in the range between  $\lambda_1$  and  $\lambda_2$ " corresponds to "a colored light which has a predetermined wave length range" against the white light.

(polarizing step)

The G light passing through G dichroic filter 2 incidents to the polarizer 3 that selects P wave which has a certain linearly polarized light component and the G dichroic filter 2 passes only such P wave (Step S2). The description as "passes only P wave" corresponds to "selectively passes the light that has a predetermined linearly polarized light component".

(wave length resolving step)

The G light of which component is a P wave being selected

by the polarizer 3 incidents to a dichroic mirror 4 which has a resolving function with respect to the wave length such that the dichroic mirror 4 passes G light-b ( $\lambda > \lambda_3$ ; P wave) which has a wave length longer than  $\lambda_3$  toward PBS 6 and folds the propagation direction of the G light-a ( $\lambda < \lambda_3$ ; P wave) which has a wave length shorter than  $\lambda_3$  toward PBS 5 by the reflection (Step S3).

The wave length  $\lambda_3$  is the central wave length in the range between  $\lambda_1$  and  $\lambda_2$ . The wave length of " $\lambda_3$ " corresponds to "predetermined wave length" for the predetermined wave length range. When the wave length  $\lambda$  of the G light equals to  $\lambda_3$  (such as  $\lambda = \lambda_3$ ), the G light passes or transmits the dichroic mirror 4.

(In case of G light-a processing)  
(orientating step)

The G light-a ( $\lambda < \lambda_3$ ; P wave) incidents to PBS 5 after being reflected at dichroic mirror 4 wherein PBS 5 folds the propagation direction of the G light-a in 90 degrees and G light-a propagates to the reflective liquid crystal 7 (Step S4).

(image information superimposing step)

The reflective liquid crystal 7 rotates the polarization of the G light-a in 90 degrees (so that the P wave is converted into the S wave) as well as superimposes the image information onto the reflected G light-a called as G image light-a. The G image light-a can pass through PBS 5 since the polarization is orthogonal to the beam splitting surface of PBS 5 and therefore propagates to the next step (Step 4').

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(image light composing step)

The dichroic mirror 9 reflects the G image light-a in 90 degree angle to a projection lens which is not shown in the figures. More concretely, the reflected G image light-a is aligned in a certain optical axis to be composed with G image light-b, being processed in the other optical process line after

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S3, into an identically single image light which directs toward a direction in such a single optical axis (Step S6).

(In case of G light-b processing)

5 (orientating step)

The G light-b( $\lambda > \lambda_3$ ; P wave) incidents to PBS 6 after being reflected at dichroic mirror 4 wherein PBS 5 folds the propagation direction of the G light-b in 90 degrees and G light-b propagates to the reflective liquid crystal 8 (Step S5).

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(image information superimposing step)

The reflective liquid crystal 8 rotates the polarization of the G light-b in 90 degrees (so that the P wave is converted into the S wave) as well as superimposes the image information onto the reflected G light-b called as G image light-b. The G image light-b can pass through PBS 6 since the polarization is orthogonal to the beam splitting surface of PBS 6 and therefore propagates to the next step (Step 5').

20 (image light composing step)

The dichroic mirror 9 passes the G image light-b therethrough to a projection lens which is not shown in the figures. More concretely, the reflected G image light-b is aligned in a certain optical axis to be composed with G image light-a, being processed in the other optical process line after S3, into an identically single image light which directs toward a direction in such a single optical axis (Step S6).

The present invention is not limited to be applied to the embodiment as explained above but other applications. The present invention is applied to the optical processing unit used for the pixel-shifted G image generation in the above embodiment. However the other color light image (such as G image generation and B image generation) can be generated by changing the spectrum characteristics of a combination of a dichroic filter and dichroic mirrors. The design of the color can be carried out by such characterization.

Second embodiment

The second embodiment of the present invention is a stereo image generation system 40 as shown in FIG. 5, which is a schematic thereof. The stereo image display system comprises RB projection devices 52 for the right eyes and the left eyes, G projection devices for the right eyes and the left eyes, half wave length plates (for changing polarization) and a screen 43.

The RB projection device 52 projects R image light and B image light to the screen, wherein these two image lights are in the same polarization and composed in a single image light. The linearly polarization method used in the RB projection device 52 is same as the conventional technology as described in BACKGROUND OF INVENTION with FIG 7. The half wave length plates 41 are for rotating a linearly polarized incidental light in 90 degree. The half wave length plate is used one of two RB projection devices and one of two G projection devices so that the use of the half wave length plates to these projection devices is for either those for the right eyes or the left eyes. The project devices project the image light onto the screen 43 which diffuses the projected image in a certain view angle covering observers. The observers wear polarizing glasses 42 which have polarization system such that the polarizer for the left eye has the same polarization as that of the polarization devices for G image light and RB image light for the left eyes as well as the polarization for the right eye does for the right eyes.

The G projection device is constructed with the optical process unit according to the first embodiment so that G image light is in a single polarization but has a normal image and pixel-shifted image in slightly different wave length range even in G image light being projected onto the screen 43.

If the polarization of the G projection device and the RB projection device for the right eyes has 90 degrees rotation in their polarizations against the polarization of those for left eyes, then no half wave length plates are necessary.



Because an orthogonal polarization between the image lights for right eyes and the image lights for left eyes has been completed when the image light is projected from projection devices.

The construction of the G projection device is explained using FIG. 4. The G projection device includes an optical process unit 1, a lamp 31 for a light source and a projection lens 32. The lamp 31 emits white light to the optical process unit 1. If necessary, a reflector can assist the light to mostly be oriented to the optical process unit 1. The projection lens are for projecting and converting the light, which are originally the incidental white light emitted from the lamp 31 and then processed by the optical process unit, on to the screen 43. The optical process unit is same as that explained as the first embodiment.

Another set of projection lenses are used for the RB projection device 52 that projects R image light and B image light converted in a single beam light to the screen after passing through the projection lens.

In these construction, G light-a and G light-b are generated from white light through the optical process unit 1. The G image light is composed with the G light-a and G light-b and projected onto the screen 43 through the projection lens 32. The optical process unit 1 superimposes the G image information at the reflection on reflective liquid crystals 7 and 8. The image information is transferred to G image light-a ( $\lambda < \lambda_3$ , S wave) and G image light-b ( $\lambda > \lambda_3$ , S wave) which are in the same polarization but slightly different wave length and finally projected onto the screen 43.

The stereo image display system 40 as has been explained above has two G project devices 30, one for right eyes that projects G image light-ar ( $\lambda < \lambda_3$ , S wave) and G image light-br ( $\lambda > \lambda_3$ , S wave) and two RB project devices 52, one for right eyes that projects R image light-r (S wave) and B image light-r (S wave). These four lights are projected to the screen 43 as P wave after passing through the half wave length plate and their polarization being rotated in 90 degrees. On the other hand,

the stereo image display system 40 has the other G project device 30 for left eyes that projects G image light-a1 ( $\lambda < \lambda_3$ , S wave) and G image light-b1 ( $\lambda > \lambda_3$ , S wave) and the other RB project device 52, for left eyes that projects R image light-l (S wave) and B image light-l (S wave). These four lights are projected to the screen 43 as S wave as they are. Then the lights for the right eyes and the left eyes are mutually orthogonal on the screen.

As explained above, it is possible to construct the same stereo image display system without two pieces of a half wave length plate. For example, a G project device for the right eyes projects both G image light-ar ( $\lambda < \lambda_3$ ; P wave) and pixel-shifted G image light-br ( $\lambda > \lambda_3$ ; P wave) and an RB projection device for right eyes projects both R image light-r (P wave) and B image light-r (P wave). The other G projection device for the left eyes projects both G image light-a1 ( $\lambda < \lambda_3$ ; S wave) and pixel-shifted G image light-b1 ( $\lambda > \lambda_3$ ; S wave) and the other RB projection device for left eyes projects both R image light-l (S wave) and B image light-l (S wave). By projecting all these lights, it is possible to generate high fidelity stereo image display realizing a pixel-shifted G image generation and stereoscopic image display.

As discussed above, the present invention provides the optical process unit and the application of the image display system using the optical process unit. Moreover the present invention can provides the optical process method that is used for the optical process unit. The invention has the advantages as explained below.

The inventions described in Claim 1 to Claim 5 can compose a single image light from two different wave length lights having the same polarization, wherein the single image light is superimposed of the image information. The present invention can solve the problem such that the normal image light and the pixel-shifted image light have different polarization as S wave and P wave for each other and the stereo image processing using difference of the polarization can not keep

the compatibility with the pixel-shifted image processing.  
The solution is provided by the optical process unit regarding  
the present invention that allows to generate an image light  
in a single linear polarization, wherein the image light has  
5 a normal image and the pixel-shifted image. The present  
invention can provide an optical process unit by which the  
pixel-shifted image generation and the stereo image display can  
be compatible to realize a high fidelity stereo image display  
system.

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